

FOREST RESEARCH AT A TIME OF NATIONAL CRISIS

Annual Investigative Report
Lake States Forest Experiment Station
Forest Service, U. S. Department of Agriculture

Maintained in cooperation with
University of Minnesota
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February 1941

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TABLE OF CONTENTS

	<u>Page</u>
Introduction.....	1
What we have.....	1
How to keep what we have.....	2
Efficient fire protection.....	2
Improved forest practices.....	3
Formulation of forest policies.....	7
1. Northern hardwood region.....	8
2. Pulpwood region.....	9
3. Farm forestry.....	9
4. Production costs.....	10
How to restore what has been lost.....	10
Rehabilitating devastated land.....	10
Restoring soils and controlling water by land use and forestry.....	12
Improving living conditions in the great plains through forest planting.....	13
Publications.....	14

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INTRODUCTION

The present emergency calls for a careful reconsideration of all our investigative work. The progress made on individual projects has been described in detail elsewhere. Here, therefore, will be discussed the significance of our investigative work in the several major fields as they appear in the light of the present crisis and the possible needs of a postwar period.

The defense program will of necessity influence forest research in two ways: One, through diverting attention from regular research activities. This will necessitate considerable streamlining of the current research work. Two, through placing upon research workers the obligation to contribute within their respective fields to activities which will strengthen the nation in an economic and military sense.

Viewing our research from this standpoint, of first importance is a knowledge of what resources we have, their location, availability, and condition. Second in order of importance is the knowledge of how best to handle these resources to provide for present needs and at the same time safeguard them for the future. Third in importance is the knowledge of how to restore and rebuild the resources which have been or may be depleted.

WHAT WE HAVE

The Forest Survey, a nation-wide undertaking by the Forest Service to obtain by actual field survey a reliable estimate of the timber situation, has now been completed for the Lake States region. This survey provides reasonably accurate statistics regarding the forest resources and industries for Michigan, Wisconsin, and Minnesota. This material is now in usable form for State and Regional planning and has been used effectively in State Planning Board reports, in the National Resources Board report for the northern Lake States, and in the Forest Service report to the Joint Congressional Committee.

There is now a growing demand for making this information available by individual counties. County land-use planning has become a major activity in the Department of Agriculture, and in at least 70 counties in the Lake States the question of what to do with the wild lands, zoned out of agricultural use, is of paramount importance, and this requires, first of all, a knowledge of what the forest resources in the county are. From requests received from many quarters, it appears that even rather crude

data on forest resources, present and prospective growth, markets, and pertinent suggestions on forest management, will be helpful to the counties attempting to shape a land-use policy.

The next most urgent step in our Forest Survey, therefore, is to break down the state-wide inventory data into county estimates. In some cases this can be done with considerable accuracy by utilizing cover maps prepared by State Land Economic Surveys or other agencies. In other cases the county estimates will have to be based on the Survey's own generalized type maps supplemented by some field work. These estimates at best will be approximations, but probably sufficient for general orientation.

Survey data on forest industries are already available by counties and will be further improved by the expanded cooperation with the Census Bureau in obtaining annual censuses of lumber products.

The Forest Survey data will be kept up to date by maintaining continuous records of cutting, fire losses, and checking by means of semi-permanent sample plots our knowledge of current growth and mortality.

HOW TO KEEP WHAT WE HAVE

To keep what we have calls for (a) efficient protection of the forests against fire, (b) improved forest practice, and (c) adoption of realistic forest policies based on a thorough understanding of present conditions.

Efficient Fire Protection

Fire protection is the first line of defense of our forests. In the face of emergency demands for men and money, and the possible shrinking of the CCC and WPA, this line of defense may be left too thinly held. This must not happen. We certainly cannot afford curtailed protective effort at this time. In place of a possible shrinkage of man power, we must develop better and more efficient methods for meeting the fire menace, and this calls for a better understanding of our fire problems.

The Lake States region has made great progress in forest fire protection during the last two decades. Public sentiment has been aroused, reasonably ample funds have been provided, and a well-organized protection force has been developed. As a result, the size of the average fire has been reduced 92 percent (from 550 to about 40 acres) and the number of fires per year and the total area burned, based on 5-year averages, has been falling steadily since 1934. The most urgent and obvious things have now been done, and further progress depends primarily on better technique and increased efficiency.

Foreseeing this need, the Lake States Station, in spite of limited funds, has carried on fire research as a major activity ever since it was organized. Today the demand for usable information in this field exceeds the ability of the Station, with its limited resources, to supply it.

Recently the Station submitted a fire-problem analysis for Region 9 in which the problems of fire protection were considered both from the administrative and research standpoints. This analysis points out the urgent need for the continuation and amplification of the fire behavior studies under way and for a study of fire effects. A knowledge of how fires behave and why, is essential to effective protective effort, and a sound appraisal of damage is needed to define its economic limits.

No research activity is so closely tied up with and so essential to an effective forestry program as is fire research. The expenditure for forest fire research should, therefore, be in direct proportion to the expenditures for the action program. Taking Region 9 as a whole, there are 80 million acres in need of protection. The destructible values involved amount to well over 1 billion dollars. The average annual loss, conservatively estimated, is in the neighborhood of $1\frac{1}{2}$ million dollars, to say nothing of the periodic threat of catastrophic conflagrations with their appalling toll of life and property.

Under these conditions, an expenditure of \$125,000 per year in the region for fire research, or about 5 percent of the present expenditures for protection, would appear to be amply justified. On the basis of current protection expenditures, \$30,000 of this would be chargeable to the Forest Service and \$95,000 to the States. On the basis of the area in need of protection, 72 percent of the funds available for research should be expended in the Lake States and 28 percent in the Central States. In comparison with the \$125,000 needed, present annual expenditures of about \$7,000 for fire research are insignificant. To obtain a direct Congressional appropriation for fire research is probably out of the question at this time. As a part of the administrative action program, however, ample funds could doubtless be secured since fire protection admittedly is our first line of defense in the conservation of forest resources.

Improved Forest Practices

There can be no sound forest practice without the knowledge of how to cut and perpetuate the forest. Studies of effective silvicultural practice in different forest types, therefore, underlie this whole problem. In view of the forthcoming report of the Joint Congressional Committee and the Secretary's recommendations for enforced forest practice by the private owner, there has been a revival of interest among foresters and lumbermen alike as to what constitutes sound forest practice. Some 7 or 8 years ago, at the time the NRA policy was being adopted, foresters were caught more or less unprepared in recommending simple but effective silvicultural practices possible under American conditions. To forestall such unpreparedness, the Station has attempted this year to analyze just

how far research findings up to date provide a basis for making definite recommendations.

Some 13 years ago our Station set forth, in "Timber Growing and Logging Practice in the Lake States," on the basis of information then available, recommendations on (a) how to keep forest land productive, and (b) how to produce full timber crops. A comparison of the recommendations made in 1928 with those possible to formulate in 1940 offers also a measure of the progress made by the Station in building up a scientific foundation for proper silvicultural practice. For the purpose of such a comparison, the recommendations for silvicultural practice considered advisable in 1928 and in 1940 are contrasted in parallel columns.

Recommended Forest Practices
Based on Scientific Data Available in 1928 and 1940

NORTHERN HARDWOODS

1928

Natural reproduction in birch-beech-maple type no problem because of all-aged character of the forest. To prolong the life of the saw log timber, partial or selective cutting advocated with special emphasis on economic advantages. Remove $1/3$ of volume and $1/2$ to $3/4$ of value by taking cut from larger trees. Second cut of about same amount predicted in 15 to 20 years. No special slash disposal required.

1940

Removal of $2/3$ to $3/4$ of value of merchantable timber found to be too heavy if continuing periodic cuts are contemplated. Large thrifty trees are as good a risk as small ones and put on more valuable growth. Therefore, first cut should be lighter and be chiefly a salvage cutting, removing silviculturally undesirable trees of both large and small sizes. Where market exists for chemical and fire wood, opportunity is excellent for utilizing defective material. Leave as many good merchantable trees as possible to insure repeated continuous cuts. No special slash disposal needed.

JACK PINE

Jack pine reproduces best after forest fires. Heat needed for opening the closely sealed cones that accumulate on trees. Clear cutting with progressive slash burning should provide satisfactory natural regeneration.

In logging, the accumulated jack pine seed supply contained in unopened cones on trees transferred to slash. Thus clear cutting provides ample seed supply. Burning of slash after clear cutting no guarantee of satisfactory reproduction since nearly all seed destroyed by fire. Spreading cone-

1928

In mixed stands of red, white, and jack pine, remove jack pine when merchantable; leave red and white pine for further growth.

Thin overstocked stands.

1940

bearing slash over ground previously scarified by disking much surer method of regenerating jack pine, since the sun's heat on or close to ground takes the place of fire to open the cones. Scarifying prepares favorable seedbed and retards competing vegetation. Partial cutting in pure jack pine not likely to secure reproduction because trees left after cutting shed very little seed and provide too much shade.

In mixed stands the same methods advised as in 1928.

Thin only where operation will pay its way. Periodic light thinnings will increase yield.

RED AND WHITE PINE

No clear cutting unless satisfactory reproduction present or stand is to be replanted. Effectiveness of leaving 2 or 3 seed trees per acre questioned. Partial or selective cutting, leaving 10 to 25 percent of the merchantable timber for 10 to 15 years advocated. Remainder to be removed after forest has been regenerated.

Red and white pine types have almost disappeared--only 2 percent of forest land now in red or white pine forest. Where old, scattered, overmature stands still occur, and natural reproduction is present, clear cutting is permissible as a salvage measure. Where no reproduction is present, scarification of ground during good seed year before final cutting found to give good results for red pine on sandy soil. Leave a scattering of seed trees to assure a seed supply in case fire destroys reproduction; otherwise, rely on early planting in event of failure or loss of reproduction.

In young mixed stands, removal of jack pine and light improvement cuttings in red pine is advisable. Commence cuttings at about 45 years and make frequent light cuts as market justifies until final harvest cut at about 140 years.

1928

Complete disposal of slash by progressive burning recommended.

1940

With the present improved fire protection and considering the light cuttings advocated in younger stands, burning of slash is not necessary, but it should be lopped and scattered.

ASPEN-BIRCH

To perpetuate aspen, clean or partial cutting recommended as market conditions may demand. Because of great vigor of aspen suckers, clear cutting will insure reproduction. Because of rapid decay of aspen slash, no disposal recommended.

To facilitate natural conversion to conifers, partial or complete removal of aspen cover recommended where white pine or white spruce already established.

Conversion of aspen to more valuable species by underplanting considered advisable.

In mature or overmature stands on sites adapted for permanent management of aspen, clear cutting of all trees, defective as well as sound, advocated to permit development of thrifty uniform suckers. In young stands, thinnings at 30-35 years and 40-45 years suggested, where commercially feasible. Such thinnings should be from below rather than above because the slower growing trees of the lower crown classes are more susceptible to decay than dominant trees. Make final clear cut at 50-55 years.

On areas naturally converting to hardwoods or to conifers, conversion may be accelerated by removal of aspen and birch wherever market conditions permit. Care needed to protect valuable understory.

Aspen on sites too poor to grow merchantable products and where natural conversion is not taking place, must be planted with sturdy stock and released several times if the site is to be made again productive for timber within a reasonable time.

SWAMP FORESTS

In dense black spruce or mixed spruce and northern white cedar of different sizes, partial cutting recommended, removing not over 50 percent of merchantable stand; in spruce stands of uniform size with fair reproduction, clear cutting, or clear cutting in alternate strips 150 to 200 feet in width.

Partial cutting, not exceeding 50 percent of volume, advocated in dense stands lacking adequate reproduction, and clear cutting in stands having good reproduction. Also clear-cut overmature decadent stands since windfall hazard high, although subsequent reproduction likely to be poor. Place greater emphasis on preventing

1928

No slash disposal except along roads and swamp borders.

1940

logging damage, since many residual trees and advance reproduction needlessly destroyed. Strip cutting may have limited application in windfirm stands, but cleared strips should not be over 75 feet wide.

If reproduction is needed, slash, including bark left in pulpwood peeling, serious obstacle to reproduction and therefore should be piled compactly. In very light partial cuttings, lopping is acceptable slash disposal.

UPLAND SPRUCE-FIR FORESTS

Type not recognized as distinct, but included in swamp, pine, and aspen types.

The spruce-fir type is now of considerable economic importance. It is a mixed type composed of balsam fir, white spruce, black spruce, paper birch, aspen, white pine, jack pine, and cedar. It lends itself to partial cutting. In such cuttings effort should be made to favor the spruces and pines, but the trend is still toward balsam. Extensive areas of mature balsam should not be allowed to accumulate because of the danger of a budworm epidemic. Unnecessary logging damage should be prevented.

Slash should generally be lopped and scattered.

In contrasting the scientific bases upon which the cutting recommendations were made in 1928 and 1940, it is evident that most of the progress has been made in the better understanding of the factors affecting regeneration. Among these, increased knowledge of seed habits of the species, especially jack pine; the need of favorable soil conditions for germination, attained through scarification; and reduction of competing vegetation constitute the 3 major contributions toward better forest practice.

Formulation of Forest Policies

That the forests of the Lake States region, as well as those of the country as a whole, are rapidly diminishing, in spite of some optimistic

interpretations of Forest Survey data, is an indisputable fact. That the loss of such a strategic resource is a weakness in national strength is another indisputable fact. The tempo of forest destruction may be accelerated under the pressure of increased demand for lumber and pulp. How to prevent the disappearance of the forest and yet satisfy all the needs for forest products that may arise during the emergency and the ensuing reconstruction period, is a vital task.

Some of the resources of the Lake States region, although seriously threatened by current trends, are still sufficiently large and of a character to permit sustained yield management. This is particularly true in two areas in the Lake States, (1) the northern hardwood region in northeastern Wisconsin and the Upper Peninsula of Michigan, and (2) the pulpwood region of northern Minnesota. In these two areas there is still an opportunity, by timely action, to do something that will be of immense value locally and of no small significance in the national situation.

1. Northern Hardwood Region.

The Station proposes to give special attention during the next year to the northern hardwood region.

Like Douglas fir and California redwood, birch and maple from the northern Lake States is utilized for innumerable purposes throughout the country. In a region where agriculture and mining have been depressed, timber resources still support a large group of industries and give a great deal of employment to local workers. The recently completed Forest Survey indicates that from 60,000 to 70,000 men are given full- or part-time work in forestry activities in the hardwood region. About 150 million dollars of private capital is invested in plant and timber holdings. Local schools and other governmental services depend heavily upon these industries for financial support. Thus the stakes are large.

The hardwood region includes 23-1/4 million acres of land, of which 19-1/2 million are forested. The major problem, however, centers in some 2 million acres of old-growth timber, most of which is privately owned. These old-growth stands contain about 12 billion board feet of valuable hardwoods (maple, birch, beech, and basswood) and 8 billion board feet of hemlock. Under a plan of selective logging, these stands could produce about 400 million board feet of saw timber and vast quantities of rough cordwood on a permanent basis. At present, the annual drain is considerably greater than this, and most logging can be described as "clear cutting" or "high grading." Forty large mills have an annual capacity of 1,050 million board feet and have been actually cutting between 500 and 600 million. The average life of these mills operating their own timber is 11 years. Including all nearby timber, the average life could be extended to only 16 years. The prospect, therefore, is for declining industrial activity and further reversion of poor cut-over lands to public ownership.

Private ownership holds the key to the forest situation in the hardwood area. Corporations and individuals control the bulk of the remaining

merchantable timber, and the only way to prevent destructive liquidation of this timber is for the public either to regulate forest practices on private land, or to acquire the land, or a combination of both.

The proposed investigation is intended to explore the economic aspects of several proposed methods for improving forest practice by such alternative methods as (a) enactment of laws that will prevent destruction of a resource needed for national defense or in other ways vital to public interest; (b) immediate public acquisition. The studies in this connection would have to do with the amount of money needed for purchase, and the effect of the transfer and change of cutting methods on local taxes, employment, and the part-time farming situation. (c) Possibility of pooling private timber reserves under some sort of holding corporation. This proposal has been made several times by the industry itself but has never been examined scientifically.

2. Pulpwood Region.

Unlike the hardwood region, the pulpwood area of northern Minnesota is largely public or semi-public land. Most of it has been cut-over, but large areas are capable of producing another crop of spruce, balsam fir, aspen, and pine pulpwood within a few years if properly managed.

The main problem is to organize the public lands, and particularly the 4 or 5 million acres of tax-forfeited land, into economic administrative units and to provide protection from fire and trespass, and to develop a sensible small timber sale policy. This involves some rather intricate legal and administrative problems as well as a technical appraisal of the forestry needs of the lands.

The Station has been working on this problem for several years and is now organizing its findings into a comprehensive report for use by the agencies which are trying to develop a land-use policy for this area.

3. Farm Forestry.

The problems of preventing destruction of large private timber holdings and further deterioration of tax-delinquent lands, apply with equal force in the case of small farm wood lots. Farm woodlands contain 29 percent of the productive forest acreage and 24 percent of the merchantable saw-timber volume in the Lake States. In terms of volume and value of products cut they rank even higher. The economic problems connected with managing the lands and marketing their produce are probably more intricate than those on public forests and commercial timberlands.

A number of separate agencies are engaged in farm economics studies in this region--notably the State agricultural experiment stations, the Soil Conservation Service, and the Bureau of Agricultural Economics. In this situation, the logical function of the Forest Service, as the bureau representing the U. S. Department of Agriculture

in forest research, is to help coordinate the existing activities which bear on farm forestry, and to stimulate new studies in neglected corners of the field. This has been done insofar as possible in the administration of Norris-Doxey funds which are provided for cooperation with agricultural experiment stations.

The major immediate problems in farm forestry and the work being done on them are as follows: (1) marketing products cut on farms, (2) utilization of home-grown timber for improving farm buildings, (3) comparison of returns from forestry and grazing, (4) study of cooperatives in connection with small forestry enterprises.

4. Production Costs.

Many of the fundamental economic problems in the Lake States region hinge upon cost considerations and no adequate answer is going to be found to these until we have more basic data on the subject. Efforts to promote selective logging are often blocked by lack of convincing evidence of how much it will cost. Many of the labor troubles in the woods can be traced to lack of an honest measure of time involved in cutting timber of different kinds and sizes. New enterprises are sometimes discouraged for similar lack of information. Knowledge of costs often leads to their reduction, and reduction of costs of logging, hauling, milling, and distributing forest products is one of the essentials to better forest management in this region. More efficient (cheaper) conversion and distribution should make possible increased use of low-grade material, higher wages, and increased profits--in other words, social benefits.

At present the Station has no specific allotments for this purpose but is endeavoring to work up cooperative projects with other public and private agencies interested in the same problem.

HOW TO RESTORE WHAT HAS BEEN LOST

Building for the future is a job primarily for normal times. Yet it cannot be neglected altogether even in times of national crisis. If such constructive work is stopped, much of what has already been done may suffer, or be lost entirely. Moreover, in spite of all we may do, the urgencies of a national emergency may lay a heavy hand on available resources. Such sacrifices may be necessary in times of crisis, but we must not lose sight of the fact that after the emergency will come a period of reconstruction, and we must plan for it. Among the activities which aim at building for the future are studies directed toward rehabilitation of the vast acreages of cut-over and burned-over land, restoring soil fertility and water balances, and in improving living conditions in the prairie-plains states through proper land use and forest planting.

Rehabilitating Devastated Land

It has been estimated that about 15 million acres in the Lake States region are in need of forest planting. During recent years about 150,000

acres have been planted annually, and the total area reforested is about 1 million acres; only about two-thirds of it, however, entirely successful. Yet this is less than 10 percent of the estimated reforestation job. Two problems, therefore, confront the Station: (a) how to do the remaining job in a way more effective than it has been done in the past, and (b) how to carry through to maturity the plantations already established. In other words, plantation after-care.

There are three phases of work essential to the success of reforestation: (a) knowledge of the biology of seed, its collection, extraction, storage, pretreatment, and testing; (b) knowledge of how to grow sturdy nursery stock; (c) knowledge on how to establish and maintain successful forest plantations. In all these fields considerable progress has been made, but there is still a great deal of room for improvement.

To aid in the better handling of the 15,000 bushels of cones and several hundred pounds of other seeds required annually in the reforestation program of the Lake States, is the primary object of the Station's seed research. Many problems of collection, extraction, cleaning, testing, storage, and sowing of the seed must be solved as a prerequisite to better practice. Some of the Station's recent findings in this field help the seed collector and nurseryman to determine (a) when to pick pine cones, as the result of the development of a simple and reliable specific gravity test for red and white pine; (b) what cones to pick, through the discovery that red pine cones with 12 to 22 cubic centimeters water displacement produce the best yield of viable seed; (c) how long seed may be stored, by showing that red pine seed can be kept at low temperatures for 10 years without loss of viability; (d) how much seed to sow, by conducting some 4,100 germination tests during the past 12 years, by developing new germination techniques for hitherto refractory species, and by clarifying the role of animals in seed germination of several species; (e) how to handle seed, by making substantial progress in the preparation of a comprehensive seed manual.

To guide the forest nurseryman in producing most economically the 150 million good-quality plantable trees required annually in the Lake States has been the objective of the studies carried out by the Station with the financial cooperation of the Regional Forester. Findings of the past year aid the nurseryman in determining (a) how to use fertilizers effectively by showing that seedling stock can be increased in size from 30 to 50 percent through the use of specific amounts of certain fertilizers, and that peats added to the soil with complete commercial fertilizers give as good results as composts and more cheaply; (b) how to determine what kinds and quantities of fertilizers are needed by describing certain distinct ocular evidences of nutrient unbalance.

To provide improved standards for the work of maintaining hundreds of thousands of acres of established plantations in thrifty condition, at the same time not neglecting those designed to show how, where, what, and when to plant, is the purpose of the Station's research work in forest planting. Work of the past year will aid the forest planter in deciding (a) when and how much to release young forest plantations by showing the improved growth and survival resulting from timely release work; (b) what

seed sources to use by illustrating that red pine of local seed source grew and survived better than more distant sources after 10 years; (c) how to anchor shifting sands through studies showing good survival and growth of trees planted in broadcast brush.

After this consideration of the highlights of recent progress in reforestation studies, the logical question is "what about the future?" While it is realized that the emphasis of research may have to be shifted to problems of more immediate urgency in view of the critical national position, it is planned to continue reforestation studies on as comprehensive a scale as possible, but streamlining them to fit current and anticipated needs. Better methods of testing, pretreating, and storing seed should be sought as one basis of improved nursery practice. Nursery studies should aim to produce better stock at reasonable cost as the first requirement in successful planting; and in line with the trend already adopted, planting studies in this region should aim more and more to solve the problems of weeding, release cutting, thinning, pruning, and building up of understocked plantations. Such studies are essential to guide the work of the national forests and other agencies carrying on the large reforestation program in this region, and contribute to the building up of the forest resources of the Lake States.

Restoring Soils and Controlling Water by Land Use and Forestry

With the establishment of the Upper Mississippi Valley Soil Erosion Experiment Station at La Crosse in 1933, a systematic effort was begun to study the role of forests in balancing the water cycle and preventing soil loss.

Three small watersheds, one covered with ungrazed woods, another covered with grazed woods, and a third cleared of timber and grazed, and 10 large lysimeters filled with blocks of undisturbed soil, were used as experimental material. These studies gave striking proof of the ability of properly used forest land to reduce both runoff and soil loss. While practically every rainstorm adds further convincing evidence to this record, the need for additional data to prove to the skeptical that land use does have an effect on runoff and soil erosion has largely passed. That most engineers, farmers, and the general public have become conscious of the part that forests and proper land use play in runoff reduction and soil conservation is sufficiently demonstrated by the support they give to the flood control program of the Department of Agriculture.

The present need, therefore, is not for more proof of the general relations but for quantitatively accurate data for a great variety of land use and soil type combinations, which can be used in planning action programs.

This need has been clearly shown in a number of preliminary and detailed flood control surveys in this region, where the unglaciated area of southeastern Minnesota and adjoining southwestern Wisconsin presents a serious problem in soil erosion and flood control.

The detailed survey of the Kickapoo watershed, now completed, and a similar survey of the Whitewater River now nearly completed, showed further that even if accurate hydrologic data were available, there still remains the problem of finding a plan which meets the physical necessities for reducing runoff and the economic limitation of maintaining farm income. To put such a plan successfully into operation by land-use practices alone means securing continued cooperation of all the farmers in a watershed, a goal difficult to attain. In many cases this would mean supplementing land-use practices by engineering works such as detention dams which often cannot be justified by the benefits attained. What is needed, therefore, is clarification of the relationship of the Flood Control Act and the Soil Conservation Act, whose more or less related functions are not now sharply delineated from each other.

Improving Living Conditions in the Great Plains through Forest Planting

During the early days of the shelterbelt project, a great deal of field work was done to measure the effect of windbreaks on wind velocity, evaporation, radiation from buildings, soil moisture, and crop yields. Most of the field work was completed by 1937. Due to curtailment of funds and press of current work the analysis of much of this data has been delayed. Some of the data on snowdrifting has been worked up and the results published.

At present the active work on this project has been limited to the crop yield studies. These must sample a number of years, and only a rather limited amount of data can be collected in any one year because of the difficulty of locating suitable windbreaks which adjoin fields of sufficient size and uniformity to demonstrate the effects which shelterbelts have on crop yields. To date 192 fields protected by shelterbelts have been sampled at different distances from the windbreaks to show the effect on crop yields. In such studies it is not possible to separate distinctly the effect of shelterbelts from that produced by fertility gradients or other factors which affect yields but which are not related to shelterbelt influence. In order to overcome this difficulty, measurements have been made on 25 fields which are adjacent to recently planted Forest Service shelterbelts. The protection from these young belts is as yet negligible, but by making crop measurements at permanently located stations in these fields it will be possible to establish fertility levels for these spots which may then be used to adjust the crop yields observed after the shelterbelts have reached an effective size.

While these direct measurements of crop yields are more difficult to collect and less exact to analyze than wind velocities or evaporation data, they do represent the synthesis of the effects of shelterbelts on all the factors which affect plant growth, and consequently they evaluate the shelterbelts directly in terms of their effect on crop yields. They provide the last word in any debate on the effect of shelterbelts on crop yields. Because of their direct value and the ~~slow~~ rate of accumulation, these observations should be continued on as large a scale as finances permit.

Such activities, although they may have no direct bearing on immediate defense problems, are a guarantee for a strong America after the crisis is past.

PUBLICATIONS^{1/}

ARTICLES PUBLISHED

- Comments. (On "Some New Aspects of Seed Certification" by Henry I. Baldwin.)
By Hardy L. Shirley. Jour. Forestry 37: 35-36. January 1939.
- Preliminary Figures from Lake States Forest Survey. By R. N. Cunningham.
Jour. Forestry 37: 66-69. January 1939.
- Do We Have Too Many Eggs in One Basket? By R. K. LeBarron. Bimonthly Research Report, February 1, 1939. pp. 1-2.
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- The Release of Seeds from Jack Pine Cones. By R. K. LeBarron and F. H. Eyre. Jour. Forestry 37: 305-309. April 1939.
- Common-sense Appraisals for Small Timber Sales. By F. H. Eyre. Service Bull. 23: 3-4. April 17, 1939.
- Fall and Winter Food Habits of Deer in Northeastern Minnesota. By Shaler E. Alfous. Wildlife Research and Management Leaflet BS-137. 10 pp., mimeographed. May 1939.
- Why Forest Plantations Fail. By Paul O. Rudolf. Jour. Forestry 37: 377-382. May 1939.
- Review of "Tree Growth" by Daniel T. MacDougal. By Hardy L. Shirley. Jour. Forestry 37: 426-427. May 1939.
- Review of "The Plant and Its Water Supply" by E. J. Salisbury. By Paul O. Rudolf. Jour. Forestry 37: 499-500. June 1939.
- The Influence of Soil Nutrients on Drought Resistance of Two-Year-Old Red Pine. Am. Jour. Bot. 26: 355-360. By Hardy L. Shirley and Lloyd J. Meuli. June 1939.
- Timber Farming in the Cloquet District. By J. H. Allison and R. N. Cunningham. Minn. Agr. Expt. Sta. Bull. 343, in cooperation with Lake States Forest Experiment Station. July 1939. 35 pp.
- Review of "The Growth and Nutrition of White Pine (Pinus strobus L.) Seedlings in Cultures with Varying Nitrogen, Phosphorus, Potassium, and Calcium" by H. L. Mitchell. By Hardy L. Shirley. Jour. Forestry 37: 587-588. July 1939.

^{1/}Includes publications for 1939 also, since no report was issued last year.

- Influence of Moisture Supply on Drought Resistance of Conifers. By Hardy L. Shirley and Lloyd J. Meuli. Jour. Agr. Research 59: 1-22. July 1, 1939.
- Woodlands of Kansas. By E. R. Ware and Lloyd F. Smith. Kansas Agr. Expt. Sta. Bull. 285. July 1939. 42 pp.
- A Scientific Discussion of the Cutover Area of Wisconsin and the Lake States. By Raphael Zon. Wisconsin Counties: 12-14. August 1939.
- The Sportsman and the Forest. By R. K. LeBarron. M.A.C. Gopher: 12-13. September 1939.
- Some Notes on Jack Pine. The Forestry Chronicle 15: 172-174. September 1939. (Comprises Lake States For. Expt. Sta. Tech. Notes 148-151.)
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142. The Grazed Wood Lot - Potential Flood Hazard and Low-Grade Pasture. September 1938.

143. Thinning of Conifer Seedlings in the Nursery Produces Bigger but Fewer Plantable Trees. April 1939.

144. Beneficial Effect of Partial Shade on Field Survival. April 1939.

145. Top-Pruning of Conifer Stock a Doubtful Operation. April 1939.

146. Black Spruce Maintains a Year-Round Seed Supply. April 1939.

147. Black Spruce Seed Is a Limited Air Traveler. April 1939.

148. Jack Pine Seed Habits. April 1939.

149. When Do Jack Pine Seeds Germinate? April 1939.

150. Effect of Utilization Standards on Pulpwood Yield. April 1939.

151. Pulpwood Volume Losses Due to Peeling and Shrinkage. April 1939.

152. Comparative Resistance of Native Wisconsin Trees to Snow Breakage. April 1939.

153. A Fast-Growing and Winter-Hardy Poplar Hybrid Still to Be Found for the Lake States. April 1939.
154. Twenty-Five Years of Forest Fires in the Lake States. April 1939.
155. Taper Table for Jack Pine. April 1939.
156. Employment Provided by Cutting and Processing Forest Products in the Lake States. May 1940.
157. Forests Give Extensive Employment. May 1940.
158. Top-Root Ratio and Size of Top Very Important in Fall-Planted Stock. May 1940.
159. White Cedar for Deer Food. May 1940.
160. Thinned Stands Fill Up Rapidly. May 1940.
161. Effectiveness of Soil Scarification in Promoting Jack Pine Reproduction. May 1940.
162. Effect of Liquid Fertilizers on Nursery Stock. May 1940.
163. Ten Million Dollars Worth of Lumber Produced in Wisconsin, 1938. May 1940.
164. Relationship of Temperature to Dispersal of Jack Pine Seeds. May 1940.
165. Jack Pine Cones in Slash Open in Midsummer. May 1940.
166. Light Cuttings in Hardwoods Show High Quality Increment. May 1940.
167. Do Young Second-Growth Northern Hardwoods Need Care? May 1940.
168. Effect of Season on Germination and Early Survival. May 1940.
169. Fertilized Nursery Stock Shows Increased Nursery Production and Higher Field Survival. May 1940.
170. When to Pick Pine Cones. August 1940.
171. How to Keep Christmas Trees Fresh. December 1940.
172. The Animal Factor in Natural Reproduction of Jack Pine. January 1941.
173. Storage of Red Pine Seed. January 1941.
174. Blowouts in the Sandhills Reclaimed by Trees. January 1941.

175. Saving Soil Moisture for the Trees in the Northern Great Plains. January 1941.

176. Testing Cone Ripeness. January 1941.

177. Effect of Temperature on Germination. January 1941.

Forest Research Digest

Winter 1939

MANUSCRIPTS SUBMITTED FOR PUBLICATION

The Forest Situation in the Upper Peninsula of Michigan. By R. N. Cunningham, H. C. Moser, H. G. White, et al. (For U.S.D.A. Misc. Publ.)

Nursery Practice for Deciduous Trees and Shrubs. By H. E. Engstrom and J. H. Stoeckeler. (For U.S.D.A. Misc. Publ.)

Restoring Conifers to Aspen Lands in the Lake States. By Hardy L. Shirley. (For U.S.D.A. Tech. Bull.)

Climate and the Nation's Forests. By Raphael Zon. (For 1941 Yearbook of Agriculture.)

Small Sawmills of Minnesota and Their Problems. By H. G. White. (For Mississippi Valley Lumberman.)

Review of "A Survey of Research in Forest Land Ownership." By H. G. White. (For Jour. Political Economy.)

Silvicultural Management of Jack Pine in the Lake States. By F. H. Eyre and Russell K. LeBarron. (For U.S.D.A. Tech. Bull.)

Effect of Temperature on Seed Germination. By Eugene I. Roe. (For Jour. Forestry.)

Farm Forestry in the Lake States: An Economic Problem. By Raphael Zon and William A. Duerr. (For U.S.D.A. Misc. Publ.)

Longevity of Red Pine Seed. By E. I. Roe. (For Proc. of Minn. Acad. of Science.)

Snowdrift Control on Highways by Planting of Trees and Shrubs. By C. G. Bates and J. H. Stoeckeler. (For Engineering News Record.)

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The Cut-Over Region--Breeding Place of Migrants. By Raphael Zon. (For publication by Wis. State Council of United Brotherhood of the Carpenters and Joiners of America.)

RS - LS
SILVICULTURE
Harvest Cuttings
Northern Hardwoods

January 1941

HARVEST CUTTINGS (NORTHERN HARDWOODS)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Silviculture
3. LINE PROJECT: Harvest Cuttings (Northern Hardwoods).
4. PURPOSE OF WORK: To determine the best methods of cutting mature northern hardwoods both from a silvicultural and economic standpoint.
5. REVIEW OF PAST WORK: (1) Based on mill-scale studies in cooperation with Forest Products Laboratory, cost of logging small and large-size trees was analyzed. (2) Probable growth of residual stands was determined by survey of areas on private land cut to varying degrees of severity. (3) Using results obtained in cutting experiments over past 14 years, most satisfactory methods are being applied to commercial sales as part of sustained-yield management program for 5,000 acres of mature timber on Upper Peninsula Forest. Sustained-yield cut on Experimental Forest was attained for first time in 1939.
6. ACCOMPLISHMENTS DURING PAST YEAR: Approved cutting budget for Experimental Forest was reached for second consecutive year. The method most used was a light salvage cutting. In view of good demand for hemlock, most of the volume removed was of this species. Considerable utilization was also made of mature and defective spruce, balsam fir, and cedar associated with the hemlock.
7. PLANS FOR NEXT YEAR: The management of the Upper Peninsula Experimental Forest on sustained yield will be continued in accordance with the approved plan of management. In this work, methods will be sought to simplify procedure in marking, scaling, and other sales routine. Several degrees of cutting will be employed, approaching reasonable commercial practice. Studies will also be made of the effect of timber sales upon stabilization of employment of the local rural population. The results of 10 years of growth and mortality after selective cutting of different degrees will be prepared for publication. Experience of private and public agencies in application of different cutting methods to hemlock stands will be assembled and appraised.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: F. H. Eyre and J. R. Neetzel.

January 1941

HARVEST CUTTINGS (SWAMP FORESTS)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Silviculture.
3. LINE PROJECT: Harvest Cuttings (Swamp Forests).
4. PURPOSE OF WORK: To determine (1) relation of growth of swamp forests to water levels and removal of excess water and (2) best cutting and reproduction methods in spruce, tamarack, cedar, and balsam fir forests.
5. REVIEW OF PAST WORK: (1) Survey of growth as affected by drainage for agriculture (but never so utilized), undertaken in 1925, indicated increased growth along drainage ditches. Experiments in removal of excess water in peat swamps started in 1927 at Chippewa and Upper Peninsula Branches. (2) Although spruce reproduction following cutting in swamps found to be fairly good except where accumulation of slash is heavy, around swamp borders and on uplands it is not generally satisfactory.
6. ACCOMPLISHMENTS DURING PAST YEAR: (1) Trees in Chippewa drained swamp show increased growth up to 100 feet from ditches but greatest effect less than 30 feet from ditch. (2) Study on Superior Forest indicates considerable increase in spruce reproduction in swamps when slash is piled and burned or simply piled, rather than when lopped or scattered or left undisposed; study initiated to determine causes of "exposure" mortality of residual black spruce; draft of manuscript prepared for intensive study of environmental factors governing regeneration of black spruce on uplands; cutting and slash disposal experiments initiated in cooperation with Minnesota (State) Forest Service.
7. PLANS FOR NEXT YEAR: Studies of possibilities of partial cutting in spruce and conditions under which natural reproduction will result will be emphasized. Work will be concentrated chiefly on State lands on plots initiated in 1939 and 1940 in cooperation with Minnesota State Forest Service. The swamp drainage plots at the Upper Peninsula Branch will be remeasured, written up, and discontinued.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: F. H. Eyre, R. K. LeBarron, P. J. Zehngraff, and J. R. Neetzel.

HARVEST CUTTINGS (PINE TYPES)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Silviculture.
3. LINE PROJECT: Harvest Cuttings (Pine Types).
4. PURPOSE OF WORK To determine methods of cutting, slash disposal, and soil disturbance that will result in satisfactory regeneration and best growth and development of the jack, red, and white pine types.
5. REVIEW OF PAST WORK Cutting experiments started in jack pine in 1926 on Chippewa and Superior National Forests, extended to Huron Forest, 1935. Red pine cuttings begun in 1926, Chippewa Forest only. Observations on white pine entirely incidental due to scattered nature of remaining stands. Major results: Jack pine unreliable as seed tree without fire, but cones exposed to sun in slash on or close to ground open promptly during summer and disperse much seed. Exposure of mineral soil by mechanical scarification of forest floor greatly increases pine reproduction. Athens disk-type plow satisfactory implement for this work. Seedlings germinating in spring survive three times as well as those germinating in fall. Light partial cuttings in merchantable stands of mixed jack and red pine 70 to 80 years old found to be economically profitable and silviculturally desirable.
6. ACCOMPLISHMENTS DURING PAST YEAR: Application of jack pine reproduction methods on Chippewa Forest indicate: (1) scarification done after logging nearly as satisfactory as when done before; (2) scarification should precede slash disposal only a short time and if done long before will result in rank growth of weeds which seriously obstruct reproduction; there is need for careful training of slash disposal crews to insure scattering of fine cone-bearing slash over scarified ground while the coarse slash containing no cones may be left in piles. Manuscript on "Silvicultural Management of Jack Pine" submitted; report entitled "Influence of Controllable Environmental Conditions on Regeneration of Jack Pine and Black Spruce" prepared in draft form. A glaze storm in April and a windstorm in July destroyed all but one set of pine cutting plots on Chippewa Forest. Storm damage necessitated recruise of Cutfoot Experimental Forest.
7. PLANS FOR NEXT YEAR: Harvest and salvage cuttings will be continued on the Cutfoot Experimental Forest after the preparation of a new management plan necessitated by storm damage. No new experimental work at Huron and Superior branch stations, although reproduction problem in Michigan not satisfactorily solved. Efforts at large-scale application on national forests (particularly Chippewa) of Station findings on jack pine reproduction will be followed up to determine results.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: F. H. Eyre, R. K. LeBarron, P. J. Zehngraft, P. O. Rudolf, and J. A. Mitchell.

RS - LS
SILVICULTURE
Harvest Cuttings
Aspen

January 1941

HARVEST CUTTINGS (ASPEN)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Silviculture.
3. LINE PROJECT: Harvest Cuttings (Aspen)
4. PURPOSE OF WORK: To determine how aspen can be handled economically so as to ensure the maximum yield of high-quality products and vigorous growth of reproduction following cutting.
5. REVIEW OF PAST WORK: Cuttings made in 1925 in 38-year-old aspen have shown that by judicious partial cutting, growth rate of young stands can be maintained up to 48 years of age. Clear cutting produces dense reproduction of thrifty suckers. Commercial feasibility of making partial cuttings to flexible 9-inch and 10-inch diameter in accessible aspen demonstrated.
6. ACCOMPLISHMENTS DURING PAST YEAR: Because trees in the lower crown classes have a greater proportion of cull than the larger dominant trees, partial cuttings in stands 35-45 years old should be made from below rather than above. Box bolts can be cut at about 35 years. If the market improves for aspen pulpwood, thinnings can start earlier.
7. PLANS FOR NEXT YEAR: As result of terrific windstorm in July 1940, a large amount of aspen on Pike Bay Experimental Forest will have to be salvaged. From these cuttings every effort will be made to obtain further information on cull in stands of various ages and to relate cull with tree class.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: P. J. Zehngraff, R. K. LeBarron, and F. H. Eyre.

STAND IMPROVEMENT

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Silviculture.
3. LINE PROJECT: Stand Improvement.
4. PURPOSE OF WORK: To determine the silvicultural and economic value of thinning and release cutting in the forest types of the Lake States.
5. REVIEW OF PAST WORK: Red pine thinning plots established on Chippewa Forest in 1927 show that increased growth rate on thinned plots has advanced date of harvest cutting at least 10 years. Release cuttings established in plantations and natural stands of pine and spruce on four National and State forests prove benefit of such work and are the basis of cultural operations in young stands by CCC and other agencies. Series of aspen thinning plots in stands of ages 2, 13, 20, and 30 years established on Chippewa 1929 to 1939. Thinning in 20-year-old aspen promises to shorten rotation materially. Stand improvement of young northern hardwoods, begun at Upper Peninsula Branch 1928, suggests that cuttings heavy enough to improve rate of growth will cause undesirable branching of crop trees. Composition improvement is main advantage of stand improvement in young hardwoods. Ten-year remeasurement of jack pine thinnings on Chippewa shows that removal of 20 to 35 percent of basal area is about right if thinnings are to be made at 5- to 10-year intervals, and 45 to 65 percent if less frequent thinning is desired.
6. ACCOMPLISHMENTS DURING PAST YEAR: All aspen thinning plots on Chippewa show accelerated growth. A second thinning applied to 3 of Chippewa jack pine plots (stand now 31 years old), taking out commercial cut of 4 cords of pulpwood per acre on each plot, using different methods of marking. All Chippewa red pine thinning plots destroyed in glaze storm of April 1940; one jack pine thinning plot lost in windstorm of July 1940. Since examination of Christmas-tree cuttings of balsam fir on Superior Forest indicates extraordinarily low percentage of trees suitable for that purpose, stand-improvement measures were initiated with view to increasing yield of merchantable trees.
7. PLANS FOR NEXT YEAR: Since the market for pulpwood is increasing yearly, commercial thinning experiments in jack pine and possibly in aspen will be undertaken in cooperation with the Chippewa National Forest.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: F. H. Eyre, P. J. Zehngraff, R. K. LeBarron, S. R. Gevorkiantz, and J. R. Neetzel.

January 1941

STAND STUDIES

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Mensuration.
3. LINE PROJECT: Stand Studies.
4. PURPOSE OF WORK: To determine development, growth, and yield of forest stands.
5. REVIEW OF PAST WORK: (a) Stand tables were prepared for fully stocked stands of aspen, white and jack pines. These tables enabled the construction of normal yield tables for any desired standard of merchantability. (b) Growth and yield tables were also prepared for well-stocked stands of northern hardwoods, bottomland hardwoods, spruce and balsam fir types. (c) Methods for evaluating the approach of understocked stands to normality and the technique for growth prediction and site determination in uneven-aged timber were worked out for the most important types in the region.
6. ACCOMPLISHMENTS DURING PAST YEAR: About 270 yield plots and 1,000 increment core data were collected in mixed oak stands typical of farm woodlands throughout southwestern Wisconsin. This field work was done in connection with the general study of comparative returns for use of land for pasture and woods in southern Wisconsin.
7. PLANS FOR NEXT YEAR: (a) Growth and yield tables will be prepared for different sites of the oak type on the basis of comprehensive material collected in Wisconsin and other parts of the Lake States. (b) A newly developed tree classification will be tested on northern hardwoods.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: S. R. Gevorkiantz.

January 1941

TREE STUDIES

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Mensuration.
3. LINE PROJECT: Tree Studies.
4. PURPOSE OF WORK: (a) Preparation of volume tables for all commercial timber species in region; (b) determination of reliable factors to convert one measure of timber volume into another; (c) study of growth, form, and taper of individual trees and their principal products.
5. REVIEW OF PAST WORK: (a) Some 150 volume tables prepared for 24 hardwood and 8 softwood species in the Lake States; (b) factors for calculating solid contents for stacked wood, shrinkage and settling in cordwood piles, and relative bark thickness along merchantable portions of stems worked out for a number of species in the region; (c) taper tables and piece-product tables prepared for jack pine and northern white cedar; (d) generalized table showing volume of tops and limbs (wood above the sawlog portion of the tree) prepared for hardwood species in the Lake States.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) Prepared taper tables showing diameter inside bark at regular intervals by distance above ground for trees of different d.b.h. and merchantable heights for white and northern red oak; (b) made critical review of all existing tree classifications and proposed a new tree classification based chiefly on relation of individual tree to surrounding trees with respect to its future development as coming nearest to meeting demands of American silviculture.
7. PLANS FOR NEXT YEAR: In addition to working up the large volume of material collected throughout the Lake States for the preparation of taper tables for aspen, spruce, sugar maple, basswood, and yellow birch, the principal emphasis will be laid on future development and testing of the newly proposed tree classification. Tree classification is basic to forest management work--harvest cutting, thinning, etc.--and should represent rationalization of accumulated experience from our past silvicultural practice.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: S. R. Gevorkiantz, P. J. Zehngraft, J. R. Neetzel, P. O. Rudolf, and staff.

January 1941

STATISTICAL METHODS

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Mensuration.
3. LINE PROJECT: Statistical Methods.
4. PURPOSE OF WORK: (a) To develop statistical methods applicable to the solution of forest problems, (b) to increase the efficiency of experimentation through improved designs, and (c) to provide valid procedures for problems involving sampling.
5. REVIEW OF PAST WORK: (a) A large amount of experimental design and analysis has been done in connection with all of the Station's projects. (b) The reliability of the Forest Survey procedure has been analyzed statistically. (c) A manual of timber cruising has been completed.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) Reliability of Forest Survey technique in determining type proportions on small survey units was analyzed by comparison with detailed type maps of ten counties in Michigan. (b) A detailed study was begun to investigate the statistical soundness of systematic sampling as applied to forest surveys.
7. PLANS FOR NEXT YEAR: (a) The study of statistical analysis of systematic sampling will be completed. (b) Service will be furnished in analysis of statistical data as the need arises. (c) All new experiments will be designed in the light of the best available statistical knowledge.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: S. R. Gevorkiantz, R. H. Blythe, Jr., and Staff.

January 1941

PLANTING

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Regeneration.
3. LINE PROJECT: Planting.
4. PURPOSE OF WORK: To develop the best technical reforestation practice in Lake States.
5. REVIEW OF PAST WORK: (a) Direct seeding annually since 1926. (b) Experimental planting since 1931 on Huron National Forest, since 1934 near Roscommon, since 1936 on Manistee Forest, and since 1937 on Nicolet and Chequamegon Forests. (c) Conversion planting in aspen and brushlands begun on Chippewa National Forest in 1926 and on Superior Forest in 1928. (d) Plantation surveys throughout region begun in 1924.

These studies have brought out the superiority of transplants over seedlings and spring over fall planting, the ill effects of slit planting, the importance of root placement in planting, the limited application and uncertainty of direct seeding, the possibilities of successful hardwood planting, and the feasibility of converting aspen and brushland to conifers.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) About 200 acres of experimental plantations established, including completion of 10-year planting project on Huron National Forest. (b) Determined standards for underplanting storm-damaged stands on Chippewa National Forest. (c) First draft of manuscript on Reforestation in the Lake States completed. (d) Study begun on Chippewa National Forest to determine how long after planting release work is feasible. (e) Beneficial effects of broadcast brush on sand-blow planting demonstrated. (f) "Successful Direct Seeding of Northern Conifers on Shallow Water-Table Areas" published in Journal of Forestry. On the whole, satisfactory techniques for establishing coniferous plantations have been developed and put into practice.
7. PLANS FOR NEXT YEAR: Now the main effort will be devoted to developing the best methods of plantation aftercare. In addition, however, (a) further tests of seeding and planting hardwoods will be established, (b) small experimental plantings of black spruce and tamarack will be made, (c) the manuscript on "Reforestation in the Lake States" will be submitted for publication, and (d) records of all present planting tests on the national forests will be continued unless financial assistance from Region 9 is reduced.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: P. O. Rudolf, J. H. Stoeckeler, P. J. Zehngraft, R. K. LeBarron, in cooperation with Supervisors of Huron, Manistee, Nicolet, Chippewa, and Superior National Forests.

RS - LS
REGENERATION
Planting
Northern Plains

January 1941

FOREST PLANTING (NORTHERN PLAINS)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Regeneration.
3. LINE PROJECT: Forest Planting (Northern Plains).
4. PURPOSE OF WORK: To determine the feasibility of large-scale forestation and revegetation in northern plains sandy land submarginal for agriculture and subject to wind erosion.
5. REVIEW OF PAST WORK: About 300 acres planted with various species since 1931 at Denbigh Branch Station in North Dakota. Considerable replanting has been necessary because of failure due to drought and lack of adequate ground preparation and aftercare. Results of cultivation conclusively show value of keeping down weeds and grass. Cottonwood, juniper, ponderosa pine, and green ash appear to be best species. Source of seed in green ash found to be important because only seedlings of northern origin survived rigorous winters of region; moreover, seedlings of northern origin were more drought hardy. Cottonwood plantings very successful in stabilizing wind-eroded sandy areas. Shading of ponderosa pine with dead brush resulted in a considerable increase in survival on dune plantings.
6. ACCOMPLISHMENTS DURING PAST YEAR: The most important stride forward in plantation care made in the last 5 years apparently had solved the problem of low survival in cottonwood. It consists of cross cultivation without any supplemental hand hoeing and gave survival of over 90 percent in a spring 1940 planting.
7. PLANS FOR NEXT YEAR: Next season's planting will be concentrated entirely in the dune areas. The most important task will be cultivation of the existing plantations.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: J. H. Stoeckeler.

January 1941

SEED STUDIES

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Regeneration.
3. LINE PROJECT: Seed Studies.
4. PURPOSE OF WORK: To discover and assemble accurate information on all characteristics of forest tree seed that intimately affect their collection and use, chiefly in reforestation operations.
5. REVIEW OF PAST WORK: (a) In cooperation with Forest Products Laboratory, worked out satisfactory kiln schedules for white pine, red pine, and jack pine cones, and tentative schedules for white spruce and black spruce. (b) Developed successful methods for storing seed of red pine, white pine, Chinese elm, and cottonwood. Unopened jack pine cones on trees for 15 years contain viable seed. (c) Determined satisfactory pretreatments which hasten and increase germination for white pine, tamarack, white spruce, coffeetree, chittam wood, soapberry, red gum, boxelder, redbud, buffaloberry, and tentative methods for balsam fir, white cedar, red maple, sycamore, slippery elm, white mulberry, elderberry, winterberry, and about 50 others. (d) Made routine germination, purity, and cutting tests on 3,500 seed samples covering more than 280 species submitted by public and private nurserymen in Lake States and Prairie Plains regions or collected by Station staff. (e) Digestive processes of birds definitely improved germination of wild rose and poison sumac seeds but failed to improve that of wild grape, dogwood, and smooth sumac seeds. (f) Determined relationship of specific gravity to ripeness of red and white pine cones, and that between size of red pine cones and yield of viable seed. (g) Completed first drafts of four chapters of seed manual and completed seed descriptions for 40 species.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) Made germination, purity, and cutting tests on 575 seed samples. (b) Tested effect of various temperatures on germination of 15 refractory species. (c) Completed seed descriptions of 45 additional species for seed manual. (d) Completed line drawings for seed manual of seeds representing 47 species, and of germinating seedlings of 50 species. (e) Added 20 species to Station's collection of authentic seed samples.
7. PLANS FOR NEXT YEAR: Major emphasis will be placed on completion of the seed manual, including 300-odd individual species descriptions and the remaining text chapters, with the assistance of the Washington Office and men detailed from other Stations. Time permitting, (a) tests will be continued of effect of various temperatures on germination of hitherto refractory species, (b) investigations will be made of pretreatment of species which fail to give satisfactory results, (c) germination tests will be made on various species stored for 2 or 3 years or longer, and (d) the building up of Station's collection of authentic seed samples will be continued.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: P. O. Rudolf and E. I. Roe.

RS - LS
REGENERATION
Nursery
General

January 1941

NURSERY (LAKE STATES)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Regeneration.
3. LINE PROJECT: Nursery (Lake States)
4. PURPOSE OF WORK: To develop nursery practices for growing the best stock for field planting.
5. REVIEW OF PAST WORK: Fertilizer treatment on nursery stock showed large increase in plantable stock produced per unit of nursery area and slight increase in survival. Low phosphorus content in soil caused heavy over-winter loss in first-year spruce. Root pruning of 3-0 white pine increased field survival. Tentative grading standards developed for nursery stock. Prolonged cold storage was found to affect growth and survival adversely. Liquid fertilizers found to increase color and growth of stock.
6. ACCOMPLISHMENTS DURING PAST YEAR: (1) More detailed follow-up in the field made of various experiments initiated in 1937 and 1938 in nurseries. (2) Table of approximate nursery fertility requirement made for various species and age classes. (3) Well-defined ratio of viable seed sown to tree yield established for 4 species. (4) Paper on tensiometers published in Plant Physiology. (5) Some improvements made in nursery drought testing technique. (6) Preliminary tests gave data on effect of density of sowing and fertilization of hardwoods.
7. PLANS FOR NEXT YEAR: (a) Determine effect of top pruning on red and white pine. (b) Develop details of hardwood nursery culture. (c) Continue follow-up of present field-planted experiments.
8. DATE OF COMPLETION: The nursery end of the comprehensive fertilizer, root-pruning, and density-of-sowing tests will be completed in spring of 1940. Field tests of this stock will be completed in fall of 1942.
9. ASSIGNMENT: J. H. Stoeckeler and P. O. Rudolf.

RS - LS
REGENERATION
Nursery
Northern Plains

January 1941

NURSERY (NORTHERN PLAINS)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Regeneration.
3. LINE PROJECT: Nursery (Northern Plains).
4. PURPOSE OF WORK: To determine how to grow best possible planting stock for forestation of sandy submarginal lands and for shelter-belt plantings in the northern plains.
5. REVIEW OF PAST WORK: (a) At Towner Nursery problem of how best to grow ponderosa pine and Rocky Mountain juniper worked out for practically all of its phases, except a few minor points. (b) Experiments with broadleaf nursery stock indicate that watering in plains nurseries must be heavier than has generally been practiced if best growth is to be obtained and available moisture in a very fine sandy loam must be at least 4 percent above computed wilting coefficient. (c) Remarkable responses obtained in jack pine beds inoculated with mycorrhizal nursery soil and heavily treated with sulphuric acid and phosphate carrying fertilizer.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) Chemical analysis made of peat deposit just west of Towner Nursery showed it to be suitable for nursery use. (b) Liquid fertilizers such as nitrophoska gave some response on Colorado blue spruce at Towner Nursery, but failed to give any beneficial results on sickly, spotty beds of Scotch or ponderosa pine at Oakes Nursery. (c) Data obtained on effect of different spacings on pine and juniper transplants at Towner Nursery.
7. PLANS FOR NEXT YEAR: Emphasis will be placed on rounding out the entire picture of growing conifers in northern prairie soils preparatory to publishing a report on this work which has been carried on since 1933. Some additional experiments will be installed in the shelterbelt nursery at Oakes, N. Dak., on soil treatments needed to produce good ponderosa and jack pine and blue spruce.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: J. H. Stoeckeler.

RS - LS
FIRE
Control

January 1941

FIRE CONTROL (STATISTICS)

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Forest Fire Protection.
3. LINE PROJECT: Control.
4. PURPOSE OF WORK: To provide the statistical data needed for fire control planning; to make available the results of past experience; and to show the progress and development of forest fire control in the Lake States.
5. REVIEW OF PAST WORK: Available fire statistics for Minnesota and Michigan, through 1925 and 1927 respectively, compiled and analyzed. Results published as state bulletins. Michigan statistics revised and brought up to date in 1936 and 1937. Analysis made of available Lake States forest fire statistics through 1939. Summary of current Lake States fire statistics made and issued annually.
6. ACCOMPLISHMENTS DURING PAST YEAR: Annual summary of current Lake States fire statistics prepared. Began establishment of hardwood firebreaks.
7. PLANS FOR NEXT YEAR: Annual summary of current Lake States fire statistics to be prepared as in the past. State forest fire bulletins to be brought up to date when funds and personnel permit.
8. DATE OF COMPLETION: Continuing.
9. ASSIGNMENT: J. A. Mitchell and P. O. Rudolf.

RS - LS
FIRE
Behavior

January 1941

FIRE BEHAVIOR

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Forest Fire Protection.
3. LINE PROJECT: Behavior.
4. PURPOSE OF WORK: To determine the relationship of forest fire occurrence, behavior, and resistance to control, to weather, fuel, and cover conditions, as a basis for rating fire danger, protection planning, and the improvement of fire control technique.
5. REVIEW OF PAST WORK: Study of fire occurrence and behavior and of the factors responsible started in 1927 has resulted in development of workable fire danger meters for Lake and Central States and in dispatching tables based on normal rate of spread and resistance to control for recognized Lake States fuel type classes. Station has also cooperated with state and federal protection agencies in establishment and inspection of fire danger stations, in compiling and analyzing fire behavior data, and in the development of formulae for use in protection planning.
6. ACCOMPLISHMENTS DURING PAST YEAR: Further study has been made of rate of spread, resistance to control, and of modifying effect of cover on inflammability and rate of drying of forest fire fuels; dispatching tables are in preparation for all danger classes; and an analysis has been made of annual and seasonal variations in fire danger by protection units.
7. PLANS FOR NEXT YEAR: (a) Analysis of accumulated fire weather data with a view to revising present Lake and Central States danger meters; (b) continuation of study of the modifying effect of cover conditions on fire danger; (c) continuation of rate of spread and resistance to control studies; (d) correlation of past fire and weather records as opportunity offers; and (e) continued cooperation with state and federal protection agencies in development and inspection of danger stations and in analysis of fire weather records.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: J. A. Mitchell.

RS - LS
FIRE
Effects

January 1941

FIRE EFFECTS

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Forest Fire Protection.
3. LINE PROJECT: Effects.
4. PURPOSE OF WORK: To determine (a) the direct and indirect effect of forest fires under specific conditions, and (b) the normal damage resulting under typical conditions.
5. REVIEW OF PAST WORK: Fifteen permanent sample plots burned over under known conditions under observation. A region-wide study of fire damage in jack pine stands completed and a similar study in northern hardwoods started. Tables prepared for State and Forest Service use in damage appraisal, giving by forest type, size class, density of stocking, and percent killed the normal loss per acre resulting from forest fires in second-growth stands.
6. ACCOMPLISHMENTS DURING PAST YEAR: Permanent sample plots reexamined. No other work done on this project due to lack of funds and personnel.
7. PLANS FOR NEXT YEAR: If and when funds are available, work on hardwood damage study will be resumed and plans made for a comprehensive study of fire damage.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: J. A. Mitchell.

January 1945

RACIAL VARIATION AND BREEDING

1. FIELD DIVISION: Forest Management Research.
2. WORK PROJECT: Genetics.
3. LINE PROJECT: Racial Variation and Breeding.
4. PURPOSE OF WORK: To determine the importance of geographic strains and hybrids of forest species in the practice of forestry in the Lake States.
5. REVIEW OF PAST WORK: (a) Field tests of several sources of red and Scotch pines begun in 1931 and 1933 on Chippewa, Superior, and Huron National Forests. (b) In 1934 tested green ash collected from several localities in Plains region ranging from North Dakota to Oklahoma. (c) Ten clones of hybrid poplars from Oxford Paper Company planted at Cass Lake, Minn., and Denbigh, N. Dak., in 1934. (d) In 1936 established plots for testing suitability of several species of known origin on Chippewa National Forest and at Roscommon, Mich. (e) In 1937 red pine of 50 different origins planted by Allegheny Forest Experiment Station in Pennsylvania and established on new plot on Chippewa National Forest. (f) In 1938 and 1939 sowed Scotch pine, Norway spruce, and European larch of several origins each at Cass Lake, Minn., as part of international provenience tests. (g) Twenty-five additional hybrid poplar clones planted at Cass Lake, Minn., and Wellston, Mich., in 1938.

Past results have shown distinct differences between stock grown from different lots of seed of red pine, and more marked differences in case of Scotch pine, particularly as affects winter-hardiness. Among the spruces, too, there have been noticeable differences in survival according to origin. Various strains of green ash have shown considerable differences in drought hardiness. Various poplar hybrids have shown widely differing degrees of survival and height growth, but none yet seems especially promising for Lake States conditions.
6. ACCOMPLISHMENTS DURING PAST YEAR: (a) Marked differences in growth and survival of red and Scotch pine according to source shown by 10-year examination on Superior National Forest. (b) Ground prepared for planting of International Union test stock on Chippewa and Manistee National Forests. (c) Hybrid poplars show marked difference in growth according to type of ground preparation. (d) Red and jack pine stock from many sources throughout Lake States grown at Chittenden Nursery.
7. PLANS FOR NEXT YEAR: No expansion of field work is planned but major emphasis will be placed upon the analysis and writing up of 10-year results. In addition the International provenience test stock already in the nursery will be field planted on Chippewa and Manistee National Forests and some further field tests of hybrid poplars will be made.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: P. O. Rudolf, P. J. Zehngraft, and R. K. LeBarron.

January 1941

FOREST SURVEY

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Six line projects--inventory, growth, depletion, requirements, reports, and keeping data up to date. A separate sheet is devoted to each.
4. PURPOSE OF WORK: To obtain reliable forest-resource and requirements data for the Lake States, the first job was to get a general over-all picture of conditions in the three states. The second step will be to rework some of the data to permit presentation by counties. Finally, it will be necessary to make periodic readjustments to keep the figures up to date.
5. REVIEW OF PAST WORK: Field work for the general survey was started in October 1933 and is now largely completed. The compilation of data has been kept close to field work. The status of the project on January 1, 1941 was about as follows:

	<u>Percent</u>
Inventory - statistics.....	100
Inventory - mapping.....	75
Growth calculations.....	100
Depletion estimation.....	100
Requirement studies.....	100
Reports.....	<u>75</u>
Entire job.....	93
6. ACCOMPLISHMENTS DURING PAST YEAR: Details given separately for each line project.
7. PLANS FOR NEXT YEAR: To finish all reports and maps now in preparation, thus completing the over-all picture of conditions for the region as a whole. From then on the job will be to refine and improve some of the data and keep current record of timber consumption, growth, and drain.
8. DATE OF COMPLETION: First phase--1941. Other phases continuing.
9. ASSIGNMENT: R. N. Cunningham, H. G. White, J. A. Diemer, and J. W. Macon.

January 1941

INVENTORY

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Inventory.
4. PURPOSE OF WORK: To obtain regional statistics of forest areas, timber types, timber volumes, etc. Also to prepare type maps for the northern portion of the region.
5. REVIEW OF PAST WORK: The basis for the over-all inventory was a line-plot survey. Lines were run across the forested portions of the three states 10 miles apart. Sample plots were measured every one-eighth mile. More than 120,000 such plots were measured. The field survey was commenced in Minnesota in 1933 and finished in Wisconsin in 1938. Small scale type maps were assembled as a separate undertaking. The average unit for which statistics have been presented was 9 million acres; the smallest unit, 4 million acres.
6. ACCOMPLISHMENTS DURING PAST YEAR: Preparation of maps and reports was the principal activity during the year. In addition to regular Survey reports (see separate line project) county reports were prepared for Waupaca County, Wis. and Carlton County, Minn., in which the survey data were localized for use of land-use planning committees.
7. PLANS FOR NEXT YEAR: Make additional county reports. Prepare forest type map for northern portion of Lower Peninsula of Michigan and northwestern portion of Wisconsin.
8. DATE OF COMPLETION: December 1941.
9. ASSIGNMENT: R. N. Cunningham, J. W. Macon, J. A. Diemer.

GROWTH AND YIELD

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Growth and Yield.
4. PURPOSE OF WORK: To obtain a reliable estimate of current annual growth in the Lake States to compare with current drain. Also to estimate the volume that could be cut annually with good forest management ("Allowable drain").
5. REVIEW OF PAST WORK: Current annual growth was estimated in terms of board feet, cords, and total cubic volume for 14 timber species on 56 million acres of forest land in the region. Average growth per acre was also determined for old-growth, second-growth, and reproduction areas in each of 12 forest types. On the basis of these estimates and the record of age and density of existing stands, allowable annual drain, under good forest management, was computed.
6. ACCOMPLISHMENTS DURING PAST YEAR: Checking of growth estimates has been attempted from every possible angle and a few of the original forest-survey plots have been remeasured to test the allowances for natural mortality.
7. PLANS FOR NEXT YEAR: Additional semipermanent plots will be established in jack pine, oak, balsam fir, and possibly one or more other types to obtain further checks on growth and mortality. A mimeographed economic note on growth is planned.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: R. N. Cunningham, J. W. Macon, with technical assistance of S. R. Gevorkiantz.

January 1941

DEPLETION

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Depletion.
4. PURPOSE OF WORK: To determine the rate at which the forest is being diminished through industrial and domestic use, windfall, fire, insects, and disease.
5. REVIEW OF PAST WORK: Initial Region-wide estimates of forest drain have been completed. The basis for the estimate of industrial depletion was (a) a complete canvass of primary forest industries in Minnesota (1934), Michigan (1935-36), and Wisconsin (1937-38); (b) sampling of farms for fuel and fence-post production; (c) canvass of wood consumption by railroads; (d) census of consumption of wood by mines; (e) collection of available information on production of cedar products, commercial fuel wood, piling, cabin poles, and miscellaneous products; and (f) studies of utilization practices on representative logging operations in order to convert production figures into terms of drain on standing timber.
6. ACCOMPLISHMENTS DURING PAST YEAR: Studies were made of utilization standards and waste in current sawlog and pulpwood operations in northern Minnesota, to make it possible to translate production figures into terms of drain on standing saw timber, cordwood, etc. Forest Survey data were reanalyzed for the same purpose. County drain tables were prepared for Carlton and Waupaca counties.
7. PLANS FOR NEXT YEAR: Additional utilization studies are planned in several pulpwood operations. In connection with these an attempt will also be made to obtain figures on average time required to fell, limb, buck, and skid pulpwood cut from trees of various diameters. This information is needed in interpreting forest-survey data. Depletion tables will be worked up for a number of individual counties, starting with Koochiching, Minnesota; Oneida and Langlade, Wisconsin.
8. DATE OF COMPLETION: 1941.
9. ASSIGNMENT: H. G. White and J. A. Diemer.

January 1941

REQUIREMENTS

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Requirements.
4. PURPOSE OF WORK: To obtain current figures on production, consumption, imports and exports of lumber, pulpwood, and other forest products in the Lake States to be used as a basis for estimating current drain and the trends in wood utilization in this region.
5. REVIEW OF PAST WORK: All available statistics on production of lumber, pulp, fuel, and other forest products that have been issued by the Census Bureau, trade associations, and the Washington Office of the Forest Service have been assembled in convenient form. Most of these have been checked for certain years and certain areas by independent canvasses. The Station cooperated with the Washington Office in preparation of estimates of (a) lumber used in manufacturing, (b) timber used as piling, (c) timber used by railroads, (d) interstate shipments of lumber. The Station cooperated with the Bureau of Census in collecting and editing lumber production questionnaires in Wisconsin.
6. ACCOMPLISHMENTS DURING PAST YEAR: Arrangements were made with the Census Bureau and the Regional Office, Milwaukee, to extend the 1938 cooperative agreement for lumber census to Minnesota and Michigan. New data were collected on timber used in mining, railroad construction and maintenance, and on farms.
7. PLANS FOR NEXT YEAR: Lumber Census questionnaires are being mailed direct to some 2,000 Lake States operators and will be returned here for editing. A field follow-up will be made in March with assistance of Forest Supervisors and a special agent employed for the purpose. Some new information on farm consumption will be obtained in cooperation with workers on Cooperative Farm Forestry projects. Plans will be developed during the year for obtaining periodic checks on fire losses, fuel-wood production, use of wood on railroads, use in mines, and possibly use in manufacturing industries.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: H. G. White and J. A. Diemer.

January 1941

KEEPING (SURVEY) FINDINGS CURRENT

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Keeping Findings Current.
4. PURPOSE OF WORK: To improve forest-survey data and keep it up to date.
5. REVIEW OF PAST WORK: The steps being taken to improve growth estimates and to record current drain are outlined in the several line projects.
6. ACCOMPLISHMENTS DURING PAST YEAR: Adjustments were made in the inventory statements in the final Survey reports to allow for growth and drain between date of survey and date of writing.
7. PLANS FOR NEXT YEAR: Besides keeping the total figures current, it is planned to break down some of the figures into county totals and where practicable to supplement or revise the results on the basis of new data obtained from maps, photographs, and surveys of other agencies. No complete revision of estimates is planned for the next few years.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: Survey Staff.

January 1941

INTERPRETATION, ANALYSIS, AND PREPARATION OF REPORTS
(FOREST SURVEY)

1. FIELD DIVISION: Forest Survey.
2. WORK PROJECT: Survey of forest resources, present and future requirements.
3. LINE PROJECT: Interpretation, Analysis, and Preparation of Reports.
4. PURPOSE OF WORK: To present the statistical data collected in the Forest Survey and to interpret these findings in terms of economic needs of the States and the Region so that they will serve as a basis for developing forest policies.
5. REVIEW OF PAST WORK: Up to January 1939 the Station prepared 11 reports as follows:
 1. Forests of Minnesota - Areas and types.
 2. Cloquet-Superior District - Minnesota.
 3. Central Pine District - Minnesota.
 4. Introduction and definition of terms.
 5. Forest areas and timber volumes in Michigan.
 6. Hardwood and Prairie Districts - Minnesota
 7. Rainy River District - Minnesota.
 8. Volume tables.
 9. Growth methods used on survey.
 10. Forest areas and volumes - Lake States.
 - x. Forests of South Dakota.
6. ACCOMPLISHMENTS DURING PAST YEAR: The Upper Peninsula, Lake States, and Minnesota reports were submitted to Washington. The first named has been reviewed and checked and is ready for Departmental action. The other two are being revised in light of Washington Office suggestions.
7. PLANS FOR NEXT YEAR: Complete following manuscripts:
 - Forests of Carlton County (mimeograph)
 - Forest Industries and Drain (mimeograph)
 - Forests of Koochiching County (mimeograph)
 - Forest Growth in the Lake States (mimeograph)
 - Small Sawmills in Wisconsin (trade journal)
 - Pulpwood Resources of the Lake States Region
 - Wisconsin State Report (to print)
8. DATE OF COMPLETION: 1941.
9. ASSIGNMENT: R. N. Cunningham and H. G. White.

January 1941

USE OF TAX-FORFEITED LANDS

1. FIELD DIVISION: Forest Economics.
2. WORK PROJECT: New Public Domain.
3. LINE PROJECT: New Public Domain.
4. PURPOSE OF WORK: To analyze the causes, extent, and effects of tax delinquency on land use and local government; and to discover ways and means of preventing delinquency and of converting tax-forfeited lands to productive forest uses.
5. REVIEW OF PAST WORK: Analyses of problems growing out of tax delinquency presented in series of publications: (1) "Taxation in Minnesota" published by University of Minnesota, 1932; (2) "Land Utilization in Northern Minnesota," report of Governor's Committee on Land Utilization, 1934; (3) "Program for Land Use in Northern Minnesota" published by University of Minnesota, 1935; (4) "Forest Land Use in Wisconsin," report of Governor's Committee on Land Use, 1932; (5) "Idle Lands-Idle Men," published by Minnesota Resources Commission, 1938. The Station prepared all or part of above publications. In addition, Station conducted study of National Forest Contributions in Cook and Lake Counties, Minn. (1936), and cooperated with Regional Office in preparation of working plan for Big Fork Area in Minnesota (1937); and with Northern Lake States Regional Committee in its report on the Lake States (1939). As part of Forest Survey determined ownership of land and timber, and analyzed trends of ownership. Aside from these definite research assignments, personnel of project have worked with State Conservation Departments and various legislative and interim committees on proposals for improving taxation and forest land use.
6. ACCOMPLISHMENTS DURING PAST YEAR: Data on timber ownership brought up to date for regional Forest Survey report. Analysis made of practical problems involved in organizing tax-forfeited lands in Carlton County into county or community forests. Assistance given to Minnesota Division of Forestry in its preparation of report for 1940 Interim Legislative Commission on Forestry.
7. PLANS FOR NEXT YEAR: During next few years greatest emphasis will be given to study of measures for preventing large-scale liquidation of private holdings and dumping of cut-over lands upon public agencies. It is planned to explore possibilities of organizing private timber holdings in northern hardwood district for permanent management through (1) public acquisition, (2) pooling under some form of holding corporation, or (3) controlling operating practices of present owners by law. Effect of these alternative measures on local public finance, on land abandonment, on maintenance of industries, and on stability of employment will be considered. In this connection, studies will be continued of feasibility of organizing forfeited lands into county or community forests.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: R. N. Cunningham and H. C. Moser.

RE - LS
FINANCIAL ASPECTS
Private Forestry
Farm Woodland Study

January 1941

FARM WOODLAND STUDY

1. FIELD DIVISION: Forest Economics.
2. WORK PROJECT: Private Forestry.
3. LINE PROJECT: Farm Woodlands.
4. PURPOSE OF WORK: To study possibilities of (1) increasing incomes and employment of farmers and settlers engaged in harvesting and selling woodland products, and (2) improving management and increasing yields of farm woodlands and other small holdings.
5. REVIEW OF PAST WORK: Case studies of utilization and management of farm woodlands made in seven typical woodland areas throughout region. On basis of these studies prepared comprehensive report on farm-woodland problem for publication as department bulletin to be printed in 1941. Assistance given to Extension Forester in Wisconsin in organization and subsequent operation of timber-marketing cooperatives in Washburn County, Wis. Studies made in Minnesota have been utilized by Department of Conservation in developing State-forest management and timber-sale plans as they affect farmers.
6. ACCOMPLISHMENTS DURING PAST YEAR: Most effort spent in organizing new project in each of three Lake States under Cooperative Farm Forestry Act. These are described on separate project sheets. In addition, timber-yield study covering unglaciated section of Wisconsin inaugurated and approximately 250 sample plots measured. A farmer's bulletin on marketing prepared in cooperation with Minnesota Extension Forester for publication by Minnesota Extension Division.
7. PLANS FOR NEXT YEAR: Emphasis will be laid on surveys to determine what yields may be expected from existing farm woodlands and on means of increasing growth and improving quality and stocking. At the same time, as a part of the Cooperative Farm Forestry project in Richland County, Wis., an intensive study will be made of timber markets, timber values, and marketing methods to provide a basis for appraising possibilities of cooperative marketing. The workings and progress of existing cooperatives in Washburn and Bayfield counties, Wis., and on the Iron Range in Minnesota will be followed. Possibilities of cooperative organization among farmers and small operators purchasing stumpage from State and National forests in Minnesota will be investigated.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: H. C. Moser, C. J. Holcomb, and R. A. Farrington.

R - LS
FARM FORESTRY
Minnesota

January 1941

COOPERATIVE FARM FORESTRY (MINNESOTA)

1. FIELD DIVISION: Forest Economics.
2. WORK PROJECT: Farm Forestry.
3. LINE PROJECT: Farm Forestry.
4. PURPOSE OF WORK: To study the possibilities of increased use of home-produced timber on Minnesota farms.
5. REVIEW OF PAST WORK: Work initiated in 1940.
6. ACCOMPLISHMENTS DURING PAST YEAR: Survey covering 120 sample farms conducted in Winona County to determine (1) kind and quantity of wood consumed for various purposes, (2) proportion and kind of wood obtained from local woodlands, (3) need of wood for repair or replacement of farm structures, (4) extent to which farm labor is utilized in building construction and repair work, (5) comparative cost of home-produced and purchased materials. Numerous additional case studies made of buildings constructed of home-grown materials, built with farm labor.
7. PLANS FOR NEXT YEAR: Prepare final draft of farmer's bulletin on "Using Home-Grown Timber on the Farm," to be published by the Extension Division of University of Minnesota. Cooperate with Extension Division, chiefly through Winona County Agent, Agricultural Engineering, and Forestry Division of Minnesota Agricultural Experiment Station, and Soil Conservation Service in developing program for increasing use of home-grown timber on Winona County farms. The research agencies will prepare plans and designs for various types of structures, to be erected with farm labor. Records will be kept to determine costs of material and labor, and adaptability of various species and grades for different purposes. Possibilities of working out scheme for exchange of materials, services, and labor on value-for-value basis between neighbors will be examined. Building programs for approximately 12 farms will be undertaken in 1941.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: H. C. Moser and Charles White, in cooperation with Henry Schmitz of Division of Forestry, University of Minnesota.

R - LS
FARM FORESTRY
Wisconsin

January 1941

COOPERATIVE FARM FORESTRY (WISCONSIN)

1. FIELD DIVISION: Forest Economics.
2. WORK PROJECT: Farm Forestry.
3. LINE PROJECT: Farm Forestry.
4. PURPOSE OF WORK: To study returns from use of land for pasture and woods in southern Wisconsin, in relation to management of the farm as a whole.
5. REVIEW OF PAST WORK: Work initiated in 1940.
6. ACCOMPLISHMENTS DURING PAST YEAR: In cooperation with Wisconsin Agricultural Experiment Station series of twelve 5-acre pasture plots established on north slopes for determination of forage yields. One-half of these were treated to secure maximum productivity. Two additional plots established in grazed woodlands for preliminary study of forage quality, same areas being used also for a study of sampling technique in using clipped quadrats. No measurements on forage yields in paired open pastures made the first season. Six sample plots established in grazed woodlands from which livestock now excluded, for purpose of observing development of forest reproduction and timber growth. Other forestry phases of project have been closely integrated with project "Private Forestry, Farm Woodlands," in which extensive study of timber yields and timber utilization in southwest Wisconsin is being made.
7. PLANS FOR NEXT YEAR: Measurement of forage yields from 12 open pastures and approximately 24 grazed woodlands by means of livestock grazing days and clipped quadrats will begin in May 1941. A few additional pastures will be laid out on south slopes. A series of approximately 24 small grazed woodlands will be fenced to exclude livestock and plots will be established for study of natural regeneration.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: H. C. Moser and R. A. Farrington, in cooperation with H. L. Ahlgren and M. Wall of the University of Wisconsin.

January 1941

COOPERATIVE FARM FORESTRY (MICHIGAN)

1. FIELD DIVISION: Forest Economics.
2. WORK PROJECT: Farm Forestry.
3. LINE PROJECT: Farm Forestry.
4. PURPOSE OF WORK: To study the possibilities of increasing the use of farm timber in local industries and improving marketing facilities.
5. REVIEW OF PAST WORK: Work initiated in 1940.
6. ACCOMPLISHMENTS DURING PAST YEAR: A canvass of wood-using industries of lower Michigan made to determine potential markets for farm timber. Some 850 establishments interviewed and data obtained to indicate quantities, kinds, and grades of wood used, and present marketing methods in the lower part of State. The data collected have been analyzed for use in official bulletins.
7. PLANS FOR NEXT YEAR: Two manuscripts being prepared for publication: (1) "Markets for Michigan Farm Woods Products," by C. J. Holcomb and P. A. Herbert. (2) "A Directory of Michigan Industries Manufacturing Wood Products," by same authors. Additional field work will be done in one or two restricted localities to secure specific information necessary for organization of marketing pool which can service local industries with local wood. Study will be made of lumber and log requirements, by grades, of wood-using industries in a specific area; and of feasibility of securing locally, suitable material to meet those requirements. Studies will be made with assistance of Michigan State College staff members, of possibilities of increasing values of lumber produced by portable sawmills through grading and improved sawing, edging, and trimming.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: C. J. Holcomb and H. C. Moser, in cooperation with P. A. Herbert and Wm. Baker of the Department of Forestry, Michigan State College.

EROSION AND RUNOFF STUDIES

1. FIELD DIVISION: Forest Influences.
2. WORK PROJECT: Stabilization of Soils.
3. LINE PROJECT: Relation of forests to erosion and runoff.
4. PURPOSE OF WORK: Study of factors influencing soil erosion and runoff in the unglaciated area of southwestern Wisconsin and adjacent Minnesota, Iowa, and Illinois, with special emphasis upon forests.
5. REVIEW OF PAST WORK: Work conducted chiefly at Upper Mississippi Valley Soil Conservation Experiment Station near La Crosse, Wis., in cooperation with Soil Conservation Service and University of Wisconsin. (a) Records of surface runoff and soil loss taken since late 1934 on three watersheds, one timber and ungrazed, one timbered and grazed, and one cleared and grazed. Over 6-year period from 1935 to 1940 ungrazed, forested watershed lost about 0.05 inch precipitation as runoff. By contrast, grazed woods lost 2.24 inches, and open, moderately grazed pasture, 0.69 inch. (b) In 1933, constructed 10 large lysimeters which were filled with soil and different surface covers established. Observations on total precipitation, surface runoff, percolation, and soil loss maintained since establishment of cover conditions.
6. ACCOMPLISHMENTS DURING PAST YEAR: All records continued. "A Lysimeter Installation for Studying Forest Influence Problems" published by Scholz and Stoeckeler, Journal of Forestry 33: 256-260. Manuscript by Bates and Scholz, "The Use of Water by Trees, Grass, and Crops in Southwestern Wisconsin and Resultant Residues for Groundwater Replenishment," was revised and soon will be in final form.
7. PLANS FOR NEXT YEAR: The lysimeter studies and observations on the ungrazed watershed will be continued at La Crosse. A new set-up for information on wooded and open pastures, of a broader and more typical character, is needed and will be obtained as soon as funds permit. There is an urgent need for such information as a basis for flood-control planning.
8. DATE OF COMPLETION: Indefinite.
9. ASSIGNMENT: H. F. Scholz, R. G. Neu, and C. G. Bates.

January 1941

SHELTERBELTS

1. FIELD DIVISION: Forest Influences.
2. WORK PROJECT: Effect of Cover on Climate.
3. LINE PROJECT: Shelterbelts.
4. PURPOSE OF WORK: To determine the relative effectiveness of shelterbelts of different design and arrangement in ameliorating climate in the immediate vicinity.
5. REVIEW OF PAST WORK: Most work on this project, including wind and evaporation measurements as means of defining windbreak efficiency, study of radiation, some measurements of crop yields, and measurements of effect of wind reduction on soil moisture, done from 1935-37. Since then, chief activity has been crop-yield measurements conducted mainly in four northern states of Plains Region. Up to 1940, measurements had been made on total of 192 fields protected by old existing shelterbelts (63 small grain, 129 fall crops). In addition, measurements were commenced on 15 fields adjacent to recently planted standard Forest Service shelterbelts in 1939.
6. ACCOMPLISHMENTS DURING PAST YEAR: In 1940 crop-influence measurements were continued under direction of W. E. Barnes, and scope of study was somewhat increased over previous years. Total of 89 fields (31 small grain, 58 fall crops) protected by old shelterbelts measured in four northern Plains States. Measurements made, in addition, on some 27 fields adjacent to young Forest Service plantings including cotton fields in Texas and Oklahoma. Favorable crop conditions in general over region are reflected to some extent in greater number of measurements undertaken.
7. PLANS FOR NEXT YEAR: Efforts will be made to write up for publication the results of the effect of different shelterbelts on wind velocity. Dependent upon available shelterbelt funds, crop measurements will be carried on at a scale similar to that of 1940. Woolery will continue to be responsible for the southern territory and maintain contact with the moisture depletion and spacing studies established previously in Oklahoma.
8. DATE OF COMPLETION: No continuing field work is planned except for that on crop measurements which should continue for two additional years at the 1940 scope.
9. ASSIGNMENT: W. E. Barnes, R. J. Woolery, and C. G. Bates.

January 1941

PRELIMINARY WATERSHED EXAMINATIONS

1. FIELD DIVISION: Flood Control Surveys.
2. WORK PROJECT: Flood Control Surveys.
3. LINE PROJECT: Preliminary Examinations.
4. PURPOSE OF WORK: Examination of watershed to determine the existence of flood problems.
5. REVIEW OF PAST WORK: Preliminary examination reports on the St. Croix, Kickapoo, Saginaw, Zumbro, Whitewater, Souris, and Sebawaing Rivers were completed before 1940.
6. ACCOMPLISHMENTS DURING PAST YEAR: Reports on Pembina, Park, and Forest Rivers (tributaries of the Red River), Black River in Wisconsin, and Root in Minnesota completed. A report covering Red Lake, Thief, and Clearwater Rivers in Minnesota prepared and now in process of revision before submission to Washington.

Preliminary hydrologic work begun on series of stream on Wisconsin side of Mississippi between La Crosse and Prairie du Chien. At present work has consisted of setting out gages to measure snow-fall and establishment of a number of simple devices to record crest height of floods at different points on a number of streams.

Station cooperated with subcommittee of Drainage Basin Committee for Mississippi headwaters in search for suitable location for study of effect of various degrees of swamp drainage on stream regimen in general and flood flows in particular. It appears likely that subcommittee will recommend use of so-called Sunken Lake Area on Outfoot Experimental Forest.
7. PLANS FOR NEXT YEAR: Work will probably be concentrated on streams in Committee 13B area, as Station has chairmanship there. The other bureaus have their chief interest in committees outside the Station's territory and consequently are not anxious to press work in the 14A area.
8. DATE OF COMPLETION: Continuing.
9. ASSIGNMENT: C. G. Bates, R. H. Blythe, Jr., H. F. Scholz, E. J. Dortignac.

January 1941

WATERSHED SURVEYS

1. FIELD DIVISION: Flood Control Surveys.
2. WORK PROJECT: Flood Control Surveys.
3. LINE PROJECT: Watershed Surveys.
4. PURPOSE OF WORK: To make detailed surveys of approved watersheds for preparing action programs.
5. REVIEW OF PAST WORK: Kickapoo survey begun August 1938; Whitewater survey begun September 1939.
6. ACCOMPLISHMENTS DURING PAST YEAR: Report on Kickapoo survey revised several times and finally submitted to Washington.
Field work on Whitewater survey largely completed by August 1940. Forest Service's share in this consisted of study of woodlot areas and volumes and suitability of steep woodland area for public purchase program; infiltration survey involving tests on 423 plots; and detailed hydrologic studies. Floods March 30 and July 10, 1940, gave opportunity to secure much-needed information on stages at upstream points in relation to stage at gaging station at mouth, for which station flood-frequency data were available. Very close cooperation with Army Engineers was maintained in the hydrologic work. Report is now in preparation under the direction of Soil Conservation Service.
7. PLANS FOR NEXT YEAR: Completion of Whitewater report. Further detailed surveys depend on authorization from Washington.
8. DATE OF COMPLETION: Kickapoo report completed. Date of completion of Whitewater report depends on the Soil Conservation Service.
9. ASSIGNMENT: C. G. Bates, H. F. Scholz, R. H. Blythe, Jr., and E. J. Dortignac.